MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

PCM0035 – GENERAL CHEMISTRY

(All sections / Groups)

9 MARCH 2017
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 3 pages only excluding the cover page.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the Answer booklet provided.

QUESTION 1 [20 MARKS]

(a) Provide the names of the quantum numbers required to describe the distribution of electrons in hydrogen and other atoms [1.5 marks]

(b) List down all the possible combinations of quantum numbers (n, l, and m_l) for a *4d* orbital. [2.5 marks]

(c) Given an element iron (Z=26).
(i) Draw the *orbital diagram* for iron without using a noble gas core. [1.5 marks]
(ii) Specify the group of the periodic table in which iron is found. [1 mark]

(d) (i) Give two ions that are isoelectronic with S^{2-} [2 marks]
(ii) Write a balanced chemical reaction equation for the reaction of potassium with water. [1.5 marks]
(iii) Rank the following atoms in the order of increasing atomic radius (from smallest to largest):
Ba , Cl , Al , F [1.5 marks]

(e) Draw the *Lewis structure* (Lewis –dot symbol) for the following compounds:
(i) $BeBr_2$ [1.5 marks]
(ii) $CaBr_2$ [1.5 marks]

(f) Name the shape (molecular geometry) and give the AB_mE_n classification for the following compounds:
(i) CO_3^{2-} [2 marks]
(ii) CH_4 [2 marks]

(g) For the following compound in **Figure Q1**:

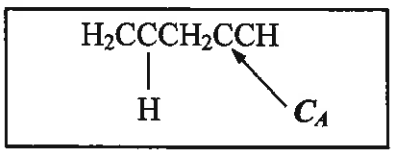

Figure Q1

(i) Predict the correct hybridization for the carbon atom, C_A, indicated in the molecule shown in **Figure Q1**. [1 mark]
(ii) Determine the number of sigma (σ) bonds and pi (π) bonds in the molecule. [1 mark]

Continued...

QUESTION 2 [15 MARKS]

(a) Define the term 'Intermolecular forces'. Give an example of it. [2 marks]

(b) Which of the following substances are capable of hydrogen-bonding among themselves in the liquid state?

CH_3CH_3, HCN, SO_3, CH_3Br, NF_3, CH_3COOH [2 marks]

(c) Complete **Table Q2c** below:

Table Q2c

	Ionic crystal	Metallic crystal	Molecular crystal
Lattice point is occupied by:	(i)	(ii)	(iii)
Hardness	(iv)	(v)	(vi)

[3 marks]

(d) For the decomposition of gaseous dinitrogen pentaoxide, $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$, the rate constant is $k = 2.8 \times 10^{-3}$ /s at 55°C. The initial concentration of N_2O_5 is 5.60 mol/L. Determine $[N_2O_5]$ after 8.00 minutes? [2 marks]

(e) The following rate data were collected for the reaction:

$$2\,NO + 2\,H_2 \rightarrow N_2 + 2\,H_2O$$

Table Q2e

Experiment	$[NO]_0$ (M)	$[H_2]_0$ (M)	$\Delta[N_2]/\Delta t$ (M/h)
1	1.20	0.30	0.20
2	1.20	0.60	0.40
3	1.20	1.20	0.80
4	2.40	1.20	3.20

Based on the information provided in **Table Q2e**, determine the *rate law* for the experiment. [4 marks]

(f) Given the reaction: $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$ + energy
Determine the direction of shift resulting from each applied stress.
(i) Addition of $O_2(g)$. [1 mark]
(ii) Removal of ammonia gas. [1 mark]

Continued...

QUESTION 3 [15 MARKS]

(a) State the *conjugate acid-base pairs* for the following equations:

$$NH_3 + HNO_3 \rightleftharpoons NH_4^+ + NO_3^-$$ [2 marks]

(b) Calculate the H^+ and OH^- concentrations (in mol/L) for the solution with pH of 12.00 [2 marks]

(c) Based on their molecular structure, identify and explain which of the following pair of acid is stronger:

(i) $HOClO_2$ and $HOClO$ [1.5 marks]

(ii) HIO_3 and $HBrO_3$ [1.5 marks]

(d) Answer the following questions based on the voltaic cell diagram in **Figure Q3** below:

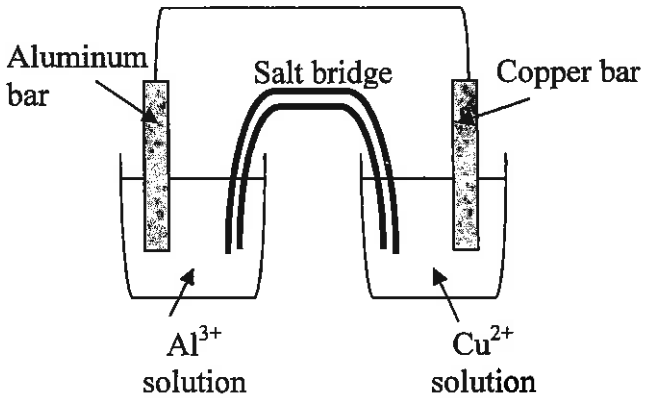

Figure Q3

(i) Write a balanced half-reaction at the anode. [1 mark]

(ii) Write a balanced half-reaction at the cathode. [1 mark]

(iii) Write a balanced overall redox reaction. [2 marks]

(iv) Identify the oxidizing agent. [1 mark]

(e) How much time would it take in minutes to deposit 5.0 gram of solid Nickel on a metal object using a current of 5A? The Nickel is reduced from +2 oxidation state to 0.
(Faraday Constant: 96500 C/mol e^- ; Atomic mass Ni = 58.69) [3 marks]

End of Paper